Why Do Oil Price Shocks No Longer Shock?[1]

Paul Segal

WPM 35

Oxford Institute for Energy Studies
New College
Department of Economics, University of Oxford

October 2007

[1] This working paper is part of an ongoing research programme on the role of oil prices in the world economy at the Oxford Institute for Energy Studies.

ISBN

978-1-901795-67-7

CONTENTS

FIGURES

ABSTRACT

This paper surveys the literature on the relationship between oil prices and the macroeconomy in order to explain why high oil prices over the past three years do not appear to have led to a slow-down the world economy. It makes three arguments. First, that oil prices have never been as important as is popularly thought. Second, that the most important route through which oil prices affect output is monetary policy: when oil prices pass through to core inflation, monetary authorities raise interest rates, slowing growth. It is argued that the direct effect of high oil prices on output is relatively small and that the microeconomic mechanisms proposed in the literature are insufficient to explain the historical impact of oil prices. Based on the second argument, the third argument is that high oil prices have not reduced growth in the past three years because they no longer pass through to core inflation, so the monetary tightening previously seen in response to high oil prices is absent.

1. INTRODUCTION

Oil prices and economic cycles have been firmly linked in the public imagination since the oil shocks of the 1970s, and the global recessions that followed. Spurred by these events, economists in the 1980s analysed the relationship in a number of econometric studies, demonstrating a negative correlation in the US and other industrial countries between oil prices and macroeconomic performance. Yet while the association is unambiguous at least in the US up to the early 1980s, at some point thereafter the relationship appeared to attenuate, and in the last few years we have witnessed a steady rise in the price of oil to historically high levels with no observable negative impact on macroeconomic indicators. In this paper I review the literature on the impact of oil price shocks and use the resulting analysis to explain the minimal impact of high oil prices today.

I will suggest that the empirical literature supports three arguments. First, oil shocks have never been as important as is commonly thought. Oil prices are just one more macroeconomic variable, and the view that they are ever the main determining factor of an economic downturn is not consistent with the evidence. While they have never been decisive they have played a role, however, and the second argument is that the most important component of the impact that oil prices have on output runs through monetary policy. If oil prices raise inflation, then monetary authorities raise interest rates, slowing activity. This argument complements the first argument because monetary authorities make policy in the light of the full range of economic news. In the 1970s, the major economies of the world were suffering from high inflation and low growth independently of the rise in the oil price. Monetary policy responded to the high level of inflation, and the oil price contributed to, but was not the sole cause of, this inflation.

This argument contrasts with several arguments regarding the microeconomic impact of high oil prices, and I present a sceptical view of the microeconomic mechanisms described in the literature. This scepticism is based on both their own results and on other findings in the literature. I therefore interpret the evidence differently from Jones et al. (2004: 1), who write that ‘the division of responsibility for post-oil-price shock recessions between monetary policy and oil price shocks has leaned heavily toward oil price shocks’. On my reading of the evidence, the division of responsibility leans more heavily towards monetary policy.

Within this context, the third argument uses the first two arguments to answer the question in the title: why is the impact of high oil prices so much smaller today than in the 1970s? Given the importance of monetary policy in the causal chain, I argue that a key difference is that oil prices no longer feed through to core inflation, so that monetary policy no longer has to tighten in response to high oil prices. Indeed, as I discuss later, high oil prices can also have a deflationary impact, requiring monetary policy to loosen. In turn, the decline in feed-through to inflation is probably due to more flexible wages, and to more credible monetary policy.

In addition to this argument I also discuss the size of the current oil price rise relative to previous oil price shocks, and dispute the popular argument that the decline in the impact of high oil prices is due to the fact that high oil prices today are ‘demand driven’, whereas they were ‘supply driven’ in the 1970s.

Section II surveys the main findings regarding the associations between oil prices and macroeconomic indicators. I discuss the early results suggesting a strong impact of oil prices, the wrinkles subsequently uncovered in the relationship including the apparent asymmetric effect of oil price rises and oil price declines, and finally the fact that oil prices appeared to lose their impact in the 1980s. Most of the literature focuses on the US economy but several studies have broadened the results to other industrial countries. In Section III I discuss a variety of microeconomic mechanisms that have been suggested in the literature. The most simple production function-based representation of the economy cannot account for the large effects found in the historical data, and researchers have proposed a range of further mechanisms in order to explain the magnitude of the observed impact. I will suggest that these mechanisms are not sufficient to account for the historical impact of oil prices, so that while they are likely to play a role in the story, they are unlikely ever to have been the driving force behind the macroeconomic impact of oil prices.

Section IV discusses the role of monetary policy, considering both empirically-based and DSGE model-based analyses of the nexus of oil prices, monetary policy, and output. The evidence suggests that monetary policy played a large role in the transmission of the impact of oil price rises, through the impact of the oil price on inflation. Section V then uses this conclusion to explain the decline in the impact of oil price rises since the 1980s, including the oil price rise of the last few years and Section VI outlines the conclusions.

2. THE KEY RELATIONSHIPS

The key finding that established the case that oil shocks cause recessions was Hamilton’s (1983) result that up to 1980, ‘All but one of the U.S. recessions since World War II have been preceded, typically with a lag of around three-fourths of a year, by a dramatic increase in the price of crude petroleum’ (p. 228). A flurry of research then confirmed this relationship across a number of rich countries. Burbidge and Harrison (1984) used vector auto-regressions (VARs) to estimate the impact of oil price rises in Canada, Japan, West Germany, the UK and the USA, using data from 1961 to 1982. Estimating the impact of a temporary one-standard deviation spike in the oil price, they find that ‘oil-price shocks increase wages and prices in all countries, albeit with appreciable variation in the size of the effect’ (p. 468). Both Germany and Japan show relatively small effects on the CPI and industrial wages, while the UK sees a small rise in wages and a larger rise in the CPI (their Figures 6 and 7, p. 466). GDP is not included in the VAR, but industrial production declines substantially in the US and Japan, and much less so in the other countries. Also using a VAR, Blanchard and Galí (2007) similarly find that oil price rises over 1970–83 had a strong effect on most rich countries, but very little effect on inflation in West Germany, or on inflation or output in Japan. Mork (1994) observed (without recourse to any formal statistical analysis) that in addition to the USA, all of Japan, West Germany and the UK suffered declines in real GDP after the oil shock of 1973–74, while of these countries only Japan avoided a decline after the 1979–80 shock. A broad consensus emerges, therefore, that only Japan avoided some strong negative effects of the oil price rises of the 1970s.

Quantifying these effects into elasticities, Rotemberg and Woodford (1996) estimated that a one percent rise in the price of oil is associated with a reduction in US output of about 0.25 percent after five to seven quarters, while Leduc and Sill (2004) find that a doubling of the oil price is associated with a 4.5 percent drop in US output. IMF (2000), using a calibrated model of the global economy (MULTIMOD), estimated that a $5 rise in the price of oil in 2001, over and above the price expected by futures markets in late 2000, would lead to a drop in global output of 0.3 percent in each of the first two years, with the US and the Euro Area down by 0.4 percent. More recently IMF (2007: 17), using their Global Economic Model (GEM), found that a supply-induced doubling of the oil price leads to a slow-down in world GDP of 1.4 percent at its trough, a little over one year after the shock, while world inflation rises by 1.5 percent at its peak, after two quarters. This wide range of papers appears to confirm Hamilton's core finding that oil price rises reduce GDP.

The first wrinkle to be documented in the relationship between oil prices and economic activity was Mork's (1989) finding of a statistical asymmetry in the impact of oil price rises and declines in the US. He found that oil price rises were followed by declines in GDP, but that declines in the oil price – including the drop of 1985–86 – were not followed by rises in GDP. Mork et al. (1994) followed up by analysing the USA, Japan, West Germany, France, Canada, the UK, and Norway over 1967 to 1992, finding asymmetry in all of these countries.

The second wrinkle was rather more serious. Darrat, Gilley and Meyer (1996) and Hooker (1996a) find that when more recent data are used, going up to the early 1990s, then the oil price no longer appears to cause declines in output. Darrat et al., using a 6-variable VAR over 1960–93, find that industrial output Granger-causes[2] oil consumption, but that neither oil consumption nor oil prices Granger-cause industrial output, even allowing for asymmetric effects. In addition to having a later time period, their study differs from Hamilton's (1983) analysis by including the interest rate as a variable. They observe that their VAR implies that 'oil prices exert significant effects on the monetary base… and then the monetary base causes significant shifts in industrial production… Thus, accommodative monetary policy appears to have weakened any economic consequences of oil price shocks' (p. 328). We will return to this argument later, in Section IV. Hooker (1996a) similarly finds that, allowing for asymmetry and other possible misspecifications, the oil price did not Granger-cause changes in US GDP for the sub-period 1973:4 to 1994:2. Hamilton's (1996) response argues for the use of his net oil price increase (NOPI) variable – which registers only those rises in the oil price that

[2] For variable x to 'Granger-cause' variable y means that, when y is regressed on lagged values of itself and of x, then some lagged values of x are significant.

are not just reversing declines of the preceding year – but even NOPI fails to Granger-cause GDP in the period in question (Hooker, 1996b).

It also seems clear that even before the 1980s the effect of oil price shocks was less than it appeared to be in the popular imagination. Hunt (2005) considers the role of the oil price shocks in the US recession of 1974–75 using a version of the IMF's Global Economic Model (GEM), and finds that 'the simulation results do not suggest that the oil price shock alone can account for the extent of the slowing in real activity and the acceleration in inflation that occurred in the United States in 1974 and 1975'. Similarly, Bernanke, Gertler and Watson (1997) find that the 1974–75 recession is not well explained by the oil shock, even allowing for an endogenous monetary policy reaction. More important was a spike in general commodity prices and the rise in interest rates caused by that spike. The decline in output over 1979–81, on the other hand, is well explained in their analysis by the oil shock and subsequent monetary policy response. But the continued decline after this point was, according to the analysis, due to an autonomous tightening of monetary policy in 1980–81 that was independent of oil prices.

One key component of the impact of oil prices on GDP is the effect of the latter on inflation, and Hooker (2002) found that oil prices fed through to core inflation in the USA up to 1981, but not after that point. Blanchard and Galí (2007) run VARs for the sub-periods 1970–83 and 1984–2006 and find much lower impacts of oil prices on both inflation and output in the second period than in the first. As will be discussed later, the decline in feed-through to inflation appears to be an important part of the story.

While these studies find that oil price shocks no longer have a significant impact on the macroeconomy, Barsky and Kilian (2004) argue that they have never been a major driver of macroeconomic cycles. They do not present formal statistical tests of the hypothesis but instead argue that oil prices are themselves determined, so some extent, by global macroeconomic conditions. In particular, they argue that the ability of a cartel like OPEC to sustain co-operation among its members is increased in times of low real interest rates (owing to the high weight that this implies on future revenues that depend on co-operation), and high growth (following a model of imperfect information by Green and Porter, 1984). They also point out, following Mabro (1988), that the impact of exogenous events in the Middle East on the oil price depends a lot on the tightness of global demand for oil, so that embargo- or war-induced price spikes are partly due to global economic conditions, in addition to the disturbances themselves.

The decline in the power of oil prices to knock macroeconomies off course has been dramatically illustrated in the last four years. Oil prices averaged only $23 over the 1990s, rising to $30 in 2003, but subsequently began a rapid rise to equal the record levels of 1979–81.[3] In September 2007 oil passed $80 a barrel. In 1996, Hamilton (1996: 220.) made the forecast that 'sometime again within the next ten years, turmoil in the Middle East will produce another major disruption to world petroleum supplies. The crisis will produce a recession in the United States'. Ten years later, in August 2006, in

[3] Oil prices are yearly averages in $2005, deflated using US CPI, from BP (2007). Prices up to 1983 are Arabian Light posted at Ras Tanura, and from 1984 are Brent dated.

the midst of the long-term US occupation of Iraq and the short-lived Israeli invasion of Lebanon, prices spiked above $70 for the first time since the beginning of the 1980s (in 2005 prices). Hamilton's prediction of turmoil in the Middle East and high oil prices was accurate. Yet the world enjoyed an average of almost 5 percent real growth over 2003–07 and is expected to remain close to this level in the coming year, while the USA seems unlikely to suffer a recession despite the slow-down caused by the recent credit crunch (Callen 2007).[4]

3. MECHANISMS FOR THE IMPACT OF THE OIL PRICE ON THE MACROECONOMY

Up until the early 1980s oil prices do seem to have had a significant impact on output. But it is surprisingly difficult for standard neoclassical economic models to account for this impact. For a neoclassical economist the most natural way to think of oil is as an input to the economy's production function. When an input gets more expensive, the profit-maximizing level of output declines. The standard way to present this argument (for example, Hamilton 2005) is with a simple model of a representative firm with the following production function:

$$Y = F(L,K,E)$$

where L is labour, K is capital, and E is energy input. With output price p, wage w, capital rent r, and the nominal price of energy p_E, profits are

$$pY - wL - rK - p_E E.$$

In a competitive market the firm buys energy up the point where its price is equal to its marginal value product:

$$p_E = pF_E(L,K,E)$$

where F_E is the partial derivative of F with respect to E. Multiplying both sides of this equation by E and dividing by pY,

$$p_E E/pY = F_E(L,K,E)E/Y.$$

The right hand side is the elasticity of output with respect to energy use, while the left hand side is the share of energy expenditures in total output.

So how much of an impact can this model account for in the US data? In most of the late 1970s the share of energy expenditures in total output was 4 to 5 percent, rising to 8 percent at the peak of the oil price spike in 1979–80. It was much lower, at 1 to 2 percent,

[4] The collapse in the US sub-prime mortgage market and its knock-on effects in financial markets appear to represent a risk to the real economy as of October 2007, but if this does lower growth then the effect can hardly be blamed on oil prices.

during the 1990s and early 2000s, and in 2005 had grown again to 3.3 percent.[5] The largest drop in oil use in the USA occurred from 1978, when 6.9 billion barrels were consumed, to 1983, when 5.6 billion barrels were consumed, a decline of 19 percent. Multiplying 19 percent times the peak expenditure share of 8 percent yields a drop in GDP, over five years, of 1.5 percent. The largest drop in oil consumption in a single year was from 1979 1980 with a decline of 7.4 percent, which would yield a drop in GDP of 0.6 percent. Negative shocks of these magnitudes are not nearly enough to turn a normal period of growth into a recession, yet, as we have seen, recessions in a number of major economies are what followed both the 1973 and the 1979 oil price shocks.

For this reason, several papers have suggested alternative routes through which the rise in the oil price can itself lead to greater declines in output than predicted by the basic model above. Hamilton (1988) develops a model, with flexible prices and wages, in which a rise in energy prices causes a decline in wages and employment in one sector relative to the rest of the economy. Assuming a delay attached to starting new employment, this leads to (a) frictional unemployment, and (b) the possibility that some workers do not take a job in another sector in the expectation that their old (and better paying) job may re-appear when energy prices decline again. Then 'the short-term aggregate loss can exceed the dollar value of the lost energy by a substantial margin' (p. 594), potentially explaining the large apparent impact of oil prices on output and unemployment. Hamilton points out that his model can be interpreted in two ways. The decline in labour demand in the first sector can be caused either by this sector being intensive in the use of energy as an input, or by the output of the sector being complementary to energy in its use. Hence the former case might apply to manufacturing industry generally, while the latter might apply to larger cars as opposed to smaller cars.

Davis and Haltiwanger (2001) describe these mechanisms as 'allocative channels' or 'the aspects of oil price changes that alter the closeness of the match between the desired and the actual distributions of labor and capital inputs' (p. 468). They then empirically test the second of Hamilton's possible channels using the example of the car industry: 'The oil price shock of 1973 increased the demand for small, fuel-efficient cars and simultaneously reduced the demand for larger cars. American automobile companies were poorly situated to respond to this shock, because their capital stock and work force were primarily directed toward the production of large cars. Consequently, capacity utilization and output fell in the wake of the oil price shock, even though a handful of plants equipped to produce small cars operated at peak capacity' (pp. 466–7). The contrast with Hamilton (1988) is that Hamilton considered the possibility of unemployment owing to simple frictions and to a reluctance by workers to take worse paid jobs when a better paid job might re-appear. Davis and Haltiwanger, on the other hand, assume that the sector in which demand rises – the production of smaller cars – cannot employ all the workers discharged by the disfavoured sector because of the nature of the physical (and perhaps human) capital stock.

This allocative channel contrasts with the 'aggregate channels' of movements in aggregate supply or demand curves, such as the decline in supply illustrated in the first

[5] Calculated using oil supply data from EIA (2006).

model above, and the demand impact of monetary policy discussed below in Section IV. Davis and Haltiwanger use their plant-level industry data to test the relative importance of the aggregate and allocative channels. They observe that the allocative channel should lead to a rise in both job destruction and job creation when oil prices rise, as labour demand rises in relatively favoured sectors (even if constraints do not allow job creation to keep up with job destruction). The aggregate channels, on the other hand, should lead to a rise in job destruction and a fall in job creation. Moreover, the allocative and aggregate channels should respond differently to declines in oil prices: a decline should have much the same effect from the allocative point of view, probably producing a net reduction in employment, whereas from the aggregate point of view, they argue, it could be expected to increase employment.

Using plant-level data they run a VAR across industries, using oil prices, a measure of credit to represent monetary conditions, and other sector-specific and common variables. From this VAR they produce impulse response functions from perturbations in the oil price. Job destruction rises sharply, peaking at the fourth quarter and then dropping to slightly below its baseline level after about eight quarters. Job creation declines, reaching its trough in the fourth quarter and then rising to somewhat above baseline from the eighth quarter. The net effect after 16 quarters is approximately zero, with 0.63 percent of all manufacturing jobs having been relocated by this point.

The authors state on this basis that 'The response pattern fits the profile of an "allocative disturbance"' (p. 488). The results do appear consistent with this mechanism, but I would suggest that they are also consistent with the response being driven by the aggregate channels they cite: after 16 quarters an economy can have fallen into a recession and then climbed back out of it, with jobs that were destroyed on the way down being replaced on the way back up. Indeed, their findings are more consistent with the aggregate channels than the allocative: the fact that job destruction declines to below baseline at the same time as job creation rises above baseline is explicable as a result of aggregate economic recovery, but not by the allocative interpretation given by the authors: there is no reason under the allocative mechanism that the increased creation of new jobs in relatively favoured industries should coincide with the reduced destruction of jobs.

They also find that a negative oil price shock has very little impact on employment, slightly reducing job destruction and thereby producing a modestly higher job rate. They suggest that this asymmetry may be due to a positive impact of the oil price decline through aggregate channels partially offsetting the negative impact of the allocative channels. As we will see later, however, asymmetry is also explicable on the basis of aggregate channels.

Using a variance decomposition, they find that oil shocks account for 18–25 percent of the variance in the employment growth (depending on alternative sectoral classifications), while the credit variable in their VAR accounts for 6–12 percent (pp. 486–7). This may appear to suggest that monetary policy is not of great importance relative to the direct effect of oil price shocks. However, these 6–12 percent are due to the components of monetary shocks that are orthogonal to contemporaneous innovations in the oil shock variable (and other unspecified shocks common across sectors). They therefore exclude the impact of monetary shocks that may be caused by changes in oil prices, and the total impact of monetary policy may include part of the 18-25 percent attributed to oil shocks. In this sense the decomposition does not answer the question of the extent to which the impact of oil price shocks work independently of monetary policy.

Davis and Haltiwanger's analysis illuminates some of the finer-grained impacts of oil price shocks and how the different channels can effect employment. Their conclusion is that 'oil shocks influence manufacturing activity through a mixture of aggregate and allocative effects' (p. 490), which is hard to disagree with, but I have suggested that their results do not support the view that the allocative effects are particularly strong.

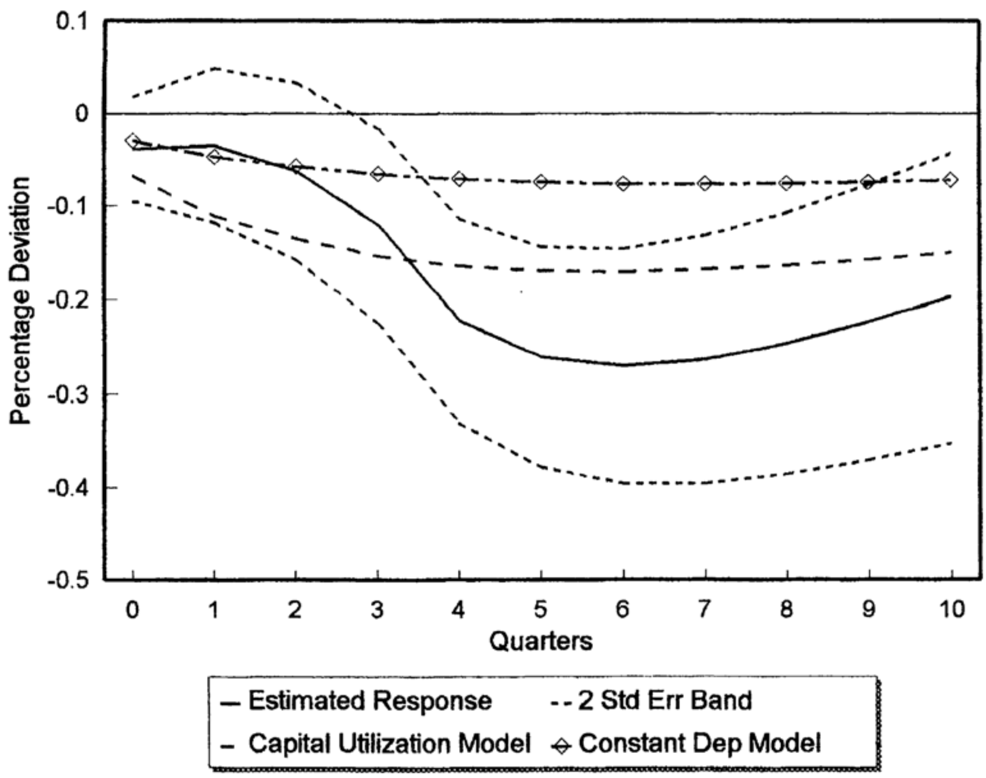
While Hamilton's (1988) model described a mechanism through which oil price shocks could have a substantial effect on the economy while assuming competitive product and factor markets, the possibility that non-competitive behaviour in markets may explain the impact of oil prices is explored by Rotemberg and Woodford (1996). They first run simple regressions to show that a 1 percent increase in oil prices results in a reduction in output of about 0.25 percent after five to seven quarters, while the real wage is nearly 0.1 percent lower in the second year after the increase. They then present a model of the economy where energy and 'materials' enter the production function along with labour and capital (similar to the simple model presented above). They calibrate the model, starting with the assumption that markets are competitive, and find that the implied impact of oil price rises is only about one quarter of the impact that they find in the data. They observe that while a larger impact on output can be produced in the model by allowing unemployment to rise, this implies a lower impact on real wages, which would also be inconsistent with the data. On the basis of these two points they argue that the impact of oil price shocks cannot be explained within a competitive framework.

They then specify the model with three different forms of non-competitive behaviour, two involving endogenous markups, and find that these models more closely replicate the empirical estimate. The most effective model is of implicit collusion between firms, in which the oil price shock leads to a rise in markups and thereby amplifies the decline in output. The calibration of this model leads to a decline in value added of about 0.2 percent from the fifth quarter on, tolerably replicating the 0.25 percent of their empirical estimate.

In response to Rotemberg and Woodford's claim that only a non-competitive model can explain the impact of the oil price, and in contrast to Hamilton's (1988) assumption of labour market frictions, Finn (2000) presents a model that is competitive and has no frictions. Her model contains two key routes through which energy impacts on production decisions. First, the level of capital utilization at a given point in time depends on the amount of energy being used. So far this simply means that energy enters the production function. But second, the rate of capital depreciation is increasing and convex in the level of capital utilization. Hence both energy costs and depreciation costs provide reasons not to fully utilize the capital stock.

She then takes Rotenberg and Woodford's empirical estimates of the impact of an exogenous one percent innovation in oil prices and compares their findings with two calibrated versions of her model: the full model as described, and a special case where utilization does not affect the rate of capital depreciation. Her full model produces substantially larger impacts than the constant depreciation version on both value added and the real wage, and these larger impacts are closer to the empirical estimates. She writes 'the capital utilization model's value added response to the exogenous shock tracks the empirical response quite well', and later, 'the capital utilization model predicts the empirical response of the value-added real wage to the exogenous innovation even better' (p. 414). The immediate problem with these claims is that, as always in such calibrations, there is no definite meaning given to the phrases 'quite well' or 'even better'. Her Figure for value added (Figure 2, p. 413) is repeated below (Figure 1), where the solid line is the empirical estimate, the short dashes represent confidence intervals, the long dashes are the capital utilization model, and the dashes with circles are the constant depreciation model. Comparing the empirical estimate with the capital utilization model – the solid line with the long dashes – the peak response in the model, around the fifth to sixth quarter, is less than two thirds of the empirical estimate (about 63 percent, reading off the figure). In the absence of a formal test of similarity the accuracy of this estimation has to remain a matter of opinion, but I would suggest that 63 percent is not a very close fit.

Figure 1: Estimated and Simulated Value Added Responses, Finn (2000)



Source: Finn (2000: Figure 2, p. 413).

Moreover, in both Rotemberg and Woodford's and in Finn's cases, the theoretical estimates produce U-shaped response curves, while Rotemberg and Woodford's empirically estimated response curve has the shape of a wave, as seen in Figure 2 (repeated from Finn). In the data, the oil price rise has only a very small impact in the first two quarters, with output dropping more rapidly from the third and fourth quarters. None of the calibrated models produced by these authors are able to replicate this pattern.

One motivation for the above studies was an important paper by Bohi (1991), who considered industrial output data in Germany, Japan, the UK and the USA at the 3-digit level. Looking at the two oil shocks in the 1970s, he found that there was no significant correlation between the energy intensity of a sector and the extent of its downturn in the first oil shock, while in the second shock there was a significant correlation only in Germany and the UK, not in the US or Japan. Jones et al. (2004: 5) argue that 'Much of [the] costly reallocation occurs at the 4-digit SIC level and consequently remains invisible at the more aggregated, 3-digit data such as those used by Bohi'. But if these re-allocation mechanisms were all that costly then we would certainly see the results of those costs in terms of reduced output at the 3-digit level. One way to look at Bohi's finding in the light of Davis and Haltiwanger's plant-level findings, therefore, is to note that the churning found by the latter study is just not very costly. It also casts doubt on Finn's (2000) mechanism: if capital utilization rates are heavily affected by oil prices, then the impact should be felt more strongly in more energy-intensive sectors.

We have seen three basic microeconomic mechanisms through which oil prices can have an impact on the macroeconomy, over and above the basic output-elasticity model first discussed in this section. Hamilton (1988) presented a model of job re-allocation costs, which was then tested by Davis and Haltiwanger (2001). Rotemberg and Woodford (1996) modelled the economy using non-competitive price markups and found that these account for the magnitude of the impact of oil prices better than a competitive model. Finn (2000) then challenged this by presenting a model where energy use determines capital utilization and the rate of capital depreciation. All of these mechanisms could plausibly play a role in the oil price-macroeconomy relationship but none was convincingly shown to be capable of explaining substantial movements in GDP, and Bohi's finding that more energy intensive industries generally do not suffer worse downturns casts further doubt on their salience. We now turn to an alternative form of explanation for the impact of oil prices.

4. OIL SHOCKS AND MONETARY POLICY

Monetary factors and aggregate demand provide an alternative explanation for the historical impact of oil prices. To understand the impact of an oil price shock from the macroeconomic point of view, it can be decomposed into two stages. In the first stage the price of petroleum products rises. Assuming that other prices are sticky downwards, this external inflationary shock raises the domestic price level. This implies lower real balances, higher interest rates, lower demand, and hence lower output. If oil imports comprise 2 percent of expenditure and the oil price doubles, then, assuming a low elasticity of oil demand, expenditure on other goods will decline by about 2 percent. Such a shock will require monetary loosening. In Solow's (1980: 263) analysis of the 1973–74 oil price shock he notes that 'Between the end of 1973 and the end of 1975, real M2 fell by 3 or 4 percent; if potential output rose by a routine 6 or 7 percent during those two years, then the equivalent reduction of the real money supply more like 10%'.[6] He argues that this tightening of the real money supply had a strong contractionary effect.[7] The impact on output could therefore have been ameliorated by relaxing monetary policy.

Another way to look at the impact of this first stage effect and its contractionary implications is to note the analogy between a rise in the price of oil and a rise in consumption taxes.[8] As OPEC countries pointed out in the 1970s, oil importers could have countered the rise in the international wholesale price of oil by reducing their own taxes on oil products. Private actors in the importing countries would thereby have experienced no change in prices paid, and instead the shock would have been absorbed by government deficits. Similarly, from the point of view of the private sector a rise in the oil price is equivalent to a rise in taxes on petroleum products, with the difference being the impact on government debt. But a rise in taxes is contractionary and, all else equal, requires a cut in interest rates.

The second round effects of the rise in the oil price follow when domestic actors are unwilling to accept the decline in real income caused by the first round effect. If workers and producers demand to be compensated for higher fuel prices then a wage–price spiral can develop. It is only in this second round that core inflation, excluding the prices of petroleum products, is affected. One important point made by Mork (1994) is that this can explain the observed asymmetry in upwards and downwards movements in the oil price if prices (and wages) are sticky downwards but not upwards.[9]

The role of monetary policy can be seen in terms of a simple Taylor rule, under which the interest rate is rising in the output gap y and in the expected rate of inflation π:

$$i = \alpha y + \beta \pi.$$

A rise in the oil price can lead to an interest rate response through both of these variables. The first round effect is contractionary in the same manner as a rise in taxes, lowering y and encouraging the monetary authority to lower the interest rate. The second round effect raises expected inflation in the future in anticipation of a wage–price spiral, encouraging the monetary authority to raise the interest rate.

[6] He also argues that supply management through lower taxes would have been required, in addition to demand stimulus, to minimize the negative impact of the oil price shock.
[7] Contrary to this, Blanchard (2001) points out that despite rising nominal interest rates, rising inflation (and inflation expectations) implied that real interest rates declined to very low levels in 1974–75, the short-term real interest rate falling below zero.
[8] Allsopp (2006).
[9] This is also consistent with Balke, Brown and Yucel's (2002) finding that monetary policy reacts asymmetrically to oil price rises: a rise in the oil price combined with price stickiness causes monetary tightening which the central bank has to loosen, while a fall in the oil price leads to a rise in other prices, keeping the real money supply steady and requiring no extra response from monetary policy.

The above model is very standard, but the question remains whether it is the right model for the current purpose. So why would one believe that monetary policy is the most important route through which oil prices affect the economy? There are two parts to the claim: first, that if one controls for monetary policy then oil prices should lose their historical impact. Second, that oil prices do indeed affect monetary policy.

The first claim is supported by the VARs estimated by Darrat, Gilley and Meyer (1996) and Hooker (1996a), which find that the impact of oil prices on US output disappears when interest rates are controlled for. Hooker (1999) then followed up by re-testing the relationship using both Hamilton's (1996) NOPI measure and Lee, Ni and Ratti's (1995) oil price transformation. The former measures only oil price rises that surpass the level of the previous year, while the latter divides oil price rises by their conditional variance, and both set price declines to zero. Hooker finds that one data point, 1957:1, is extremely influential, and without it oil prices are generally no longer significant even in the pre-1970s data. The only way that oil price variables can be made significant is by using annual as opposed to quarterly data and excluding standard control variables, including the interest and inflation rates, from the equation. Interest rates therefore appear to be an essential route through which oil prices affect output. Kilian (2007a: 23-4) also finds suggestive evidence: in his regressions short term interest rates rise in response to exogenous oil supply shocks in all countries but Japan, and Japan is the country with the lowest GDP response to the shocks of the G7 countries.

A more detailed analysis that supports both of the above claims is given by Bernanke, Gertler, and Watson (1997) (henceforth BGW), who use a structured VAR to investigate the role of macroeconomic policy rules in determining the macroeconomic response to an oil price shock. Standard empirical estimates including VARs suffer from the problem that 'It is not possible to infer the effects of changes in policy rules from a standard identified VAR system, since this approach typically provides little or no structural interpretation of the coefficients that make up the lag structure of the model' (BGW: 92). In particular, the practice of using a VAR to predict what the impact of some counterfactual monetary policy would have been suffers from the Lucas critique: the structure of the economy is partly determined by agents' expectations about variables in the economy, including the interest rate, and the parameters estimated in the VAR reflect these expectations. Hence if the monetary policy rule (or reaction function) changes, and agents in the economy know that it has changed, then the parameters estimated under the original reaction function will no longer be appropriate. The counterfactual of a different monetary policy cannot therefore be tested simply by changing the interest rate variable in the estimated VAR. Put another way, a change in the monetary policy rule does not just change the behaviour of the interest rate, but it also changes the behaviour of economic actors in response to a given state of the world. An empirical simulation that merely changes the interest rate will therefore not capture the full effect of a change in the monetary policy rule.

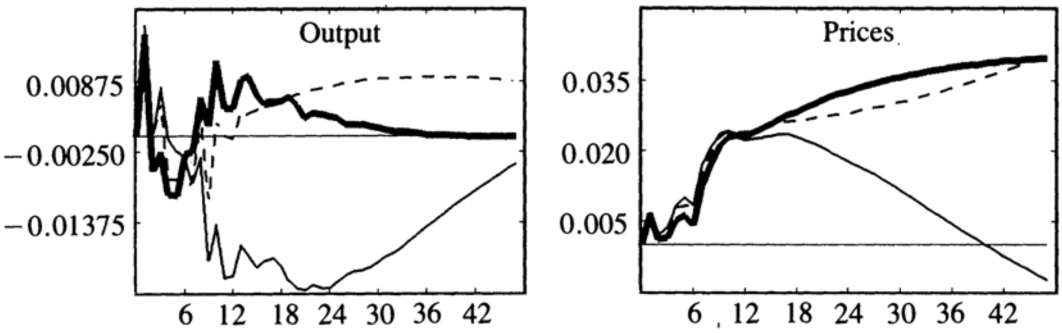
To reduce the sensitivity of their analysis to the Lucas critique, BGW add some structure to their VAR by assuming that 'monetary policy works its effects on the economy through the medium of the term structure of open-market interest rates; and that, given the term structure, the policy instrument (in our application, the federal funds rate) has no independent effect on the economy'.

The line of causation is therefore that the federal funds (FF) rate and its expected future values determine market interest rates, and market interest rates in turn determine variations in output. By incorporating expectations about the FF rate into the model this method suffers less from the Lucas critique. The strategy is based on two assumptions. First, that the term structure of market interest rates can be modelled as depending on the FF rate and expectations about its evolution (in addition to other macroeconomic variables), and that the parameters in this relationship do not depend on the reaction function itself. Put another way, the market cares about what levels the FF rate takes going forward, but not about why the central bank chooses those levels. Second, they assume that the term structure of market interest rates is the only route through which the FF rate affects the economy. If these two assumptions are correct, then the model is not vulnerable to the Lucas critique.

With this model they run three different types of simulation in response to a rise in the oil price. First, they run a standard VAR simulation allowing the FF rate to change in response to the oil price, as in the data. Second, they simply fix the FF rate at its base value throughout the simulation. It is this exercise that is particularly vulnerable to the Lucas critique. Third, desribed as 'anticipated policy', they apply the methodology described above: they shut off the monetary policy response by fixing the FF rate at its base value, and set market interest rates (and hence market expectations) to be consistent with this future path of the FF rate.

In the second and third cases both prices and output are higher, as expected, with the third simulation slightly higher than the second: 'a nonresponsive monetary policy suffices to eliminate most of the output effect of an oil price shock, particularly after the first eight to ten months' (p. 118). Their Figure 4, with the estimated responses, is repeated here. They point out that 'The conclusion that a substantial part of the real effects of oil price shocks is due to the monetary policy response helps to explain why the effects of these shocks seems larger than can easily be explained in neoclassical (flexible price) models'.

Figure 2: Responses to a Hamilton Oil Price Shock, Bernanke et al. (1997)



Thin line: standard VAR. Dotted line: fixed FF rate, no expectations. Thick line: fixed FF rate with consistent expectations.
Source: Bernanke et al. (1997: Figure 4, p. 117).

Their final experiment is to compare the impact of an oil price shock and concomitant endogenous monetary policy response with the impact of the same monetary policy change with oil prices kept constant. They find that the impact on output is virtually identical, although the impact on prices is not the same: prices first rise and then fall under an oil shock, whereas they just fall under autonomous monetary policy. The rise in prices under the oil price spike, they suggest, may be what explains the concomitant rise in interest rates – the 'second round' effect on inflation discussed above. The authors conclude that 'the majority of the impact of an oil price shock on the real economy is attributable to the central bank's response to the inflationary pressures engendered by the shock' (p. 122).

Hamilton and Herrera (2004) criticise BGW on the basis that they allow oil price shocks to affect the economy only up to a maximum lag of just 7 months. The authors chose this lag length on the basis of the Akaike information criterion, minimizing noise in the data at the cost of losing some real information. Bernanke et al. (2004) respond by using quarterly data with six lags, and hence allowing the impact of an oil shock to be lagged up to a year and a half. However, in response to Hamilton and Herrera's further objection that they have not avoided the Lucas critique, they also freeze monetary policy for only one year and then allow it to follow its usual estimated path. In this case they find that monetary policy accounts for about half of the drop in output following an oil price spike. Unfortunately they do not run their full previous model with the quarterly data so it is not possible to tell how much of this new result is due to the longer lag and how much to the reversion to normal monetary policy after one year. Clearly, the quarterly simulation with monetary policy persisting longer than a year would have resulted in a larger weight on monetary policy.

Are Hamilton and Herrera right to claim that BGW falls foul of the Lucas critique? Perhaps, but only if one applies a far more exacting standard of plausibility than anyone applies to the calibrated DSGE models described here. This is because if the two assumptions that BGW make are true, then the model is expectations-consistent and the Lucas critique does not apply. But DSGE models normally involve the same two assumptions, and many more besides; if one rejects the assumptions then one rejects a lot of macroeconomics.

Leduc and Sill (2004) address the same question as BGW using a calibrated DSGE model instead of empirical VAR estimates. By using a fully-specified model they do not suffer from the Lucas critique and are able to build in alternative monetary policy rules, and consistent expectations, in order to estimate how they affect the impact of an oil price shock. The model is based on monopolistic competition and differentiated goods in product markets. Wages and prices are both sticky, with quadratic costs to adjusting them at a rate different from the growth of the money supply. They follow Finn (2000) in assuming that the utilization rate of capital is an increasing function of energy use per unit of capital stock, and that capital depreciation is an increasing function of capital utilization.

Using a simple Taylor rule based on Fed policy over 1979–95 (estimated by Orphanides, 2001) for the monetary policy reaction function, they calibrate the model to replicate the finding of a 4.5 percent drop in GDP in response to a doubling of the oil price. In order to estimate the impact of an oil price shock they start by estimating the impact under what they call a ‘k-percent rule’: the money supply is increased by an exogenous (and unspecified) k percent each period. The reaction of the economy to a doubling of the oil price under this monetary policy is taken to be the pure effect of the oil price shock, indicating a different interpretation of ‘neutral’ monetary policy from the constant interest rate simulated by BGW. When the impact on output under the k percent rule is compared with the impact on output under the Taylor rule, monetary policy under the Taylor rule ‘accounts for’ the difference between the two estimated output responses. The difference is 37 percent of the total response: that is, output falls by 37 percent less under the k-percent rule than under the Taylor rule that the Fed is estimated to have actually followed. Other monetary policy rules, including a constant interest rate, are found to have less of an impact. Their conclusion is that monetary policy can be considered to make up 37 percent of the impact on an oil price shock on output.

These two different analyses of monetary policy – the empirical estimates of BGW and the DSGE estimates of Leduc and Sill – both imply that monetary policy is at least an important factor in determining the impact of oil prices. The interaction of oil prices and monetary policy is decomposed more explicitly by Hunt, Isard and Laxton (2001). These authors use a version of the IMF’s MULTIMOD model. The model comprises a monetary policy reaction function based on the deviation of observed output from potential output, and the deviation of forecast core inflation from the inflation target, like the Taylor rule described above. In addition there is a reduced-form, expectations-augmented Philips curve for core inflation (which is defined as the GDP deflator excluding oil).

In their calibrations a 50 percent rise in the price of oil has a direct contemporaneous effect on the CPI – through gasoline and other direct energy costs – of 1.3 percentage points in both the US and the Euro Area, 0.6 points in both Japan and the UK, and 0.8 points in Canada. The impact on core inflation then works through two routes in the model: the CPI appears directly in the core inflation equation, on the basis that workers demand wage rises in response to rises in the CPI and that this leads to rises in costs and hence core prices; and expectations of future CPI rises also enter the core inflation equation. The authors consider these to be two different routes, but presumably the expectations term also requires some kind of wage catch-up mechanism to justify it. Both elements would therefore seem to reflect some of the second round effects described above. Be that as it may, the core inflation equation has two coefficients for each of these two routes, which are estimated across the different countries.

As expected, the impact on core inflation varies with these two parameters. When these parameters are set to their average levels across the industrialized countries, the CPI jumps up in response to an oil price spike and then is maintained at an elevated level. Core inflation rises more gradually but then also remains steady at a higher level. When the parameters are set to zero the CPI experiences the same initial jump, but then settles back to base level, while there is no impact on core inflation. The model thereby captures the idea of oil price pass-through. The authors then use the model to simulate the impact of the oil price shock on output as well as the two inflation rates, and the result is essentially what would be expected: using the same Taylor rule for monetary policy, the varying values for the two price pass-through parameters across countries lead to different impacts on output, with higher pass-through generally leading to larger drops in output.

These studies all suggest that the inflationary effect of oil price rises and its resultant effect on monetary policy is an important route through which oil prices affect output. According to the empirical estimates of BGW, it appears to be the dominant route. One finding of particular significance is that a rise in the interest rate that is not accompanied by a rise in the price of oil has the same impact on output as a rise in the price of oil. While Hamilton and Herrera's (2004) critique moderated the conclusions of BGW by forcing them to allow longer lags, it did not undermine the message that monetary policy is extremely important. We now use these findings to help to explain the reduced impact of oil prices today.

5. THE DECLINE IN THE IMPACT OF OIL SHOCKS

Monetary policy and inflation

We saw earlier that oil prices seem to have lost their ability to shock macroeconomies since the 1980s, and that the very high oil prices experienced over the past three years appear to have had no deleterious effect on global growth. So how does the role of monetary policy help to explain the decline in the impact of oil prices? One obvious possibility is that monetary policy may be different this time around. Hooker (2002) finds that oil prices stopped feeding through to core inflation some time in the early 1980s, and that the decline in the energy intensity of the economy, and deregulation of prices, are not able to explain the break. One explanation might be that more reactive monetary policy nipped any incipient wage–price spiral in the bud, avoiding the need for stricter monetary tightening later on. However, Hooker also finds that monetary policy became less rather than more strict in its response to oil price shocks. Tighter monetary policy therefore cannot explain the decline in pass-through. His suggestion, instead, is that the causality may in fact be the reverse: the reduced pass-through of oil prices to core inflation may explain the reduced monetary policy reaction in the later period.

The monetary policy component of the explanation for the decline in the impact of oil prices on output therefore seems to rest on the fact that oil prices have less of an impact on core inflation than in the past, obviating the need for monetary tightening. The decline in the second round pass-through means that workers and firms simply accept the decline in real income caused by the rise in the price of petroleum products. In terms of the

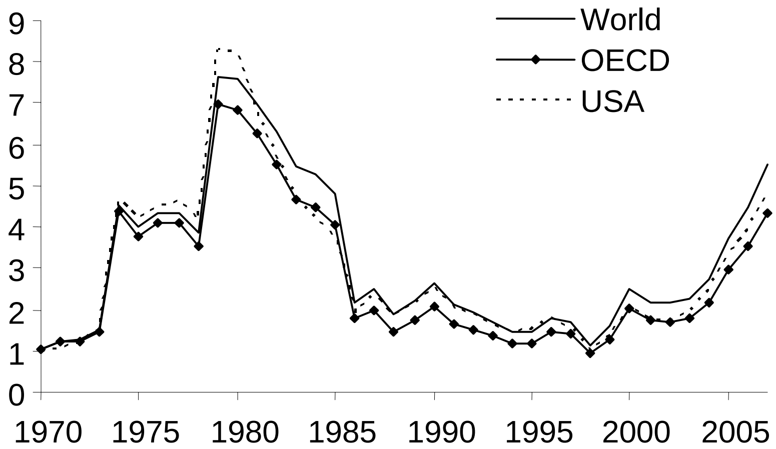
Taylor rule described earlier, the inflation component is absent and interest rates do not need to rise. Indeed, the contractionary effect of the high oil price may be dominant, in which case the high oil prices of the last few years may have contributed to the historically low interest rates seen over the same period.[10]

The key question then becomes why oil prices no longer pass through to core inflation. This matter requires further research, but one can point to some plausible hypotheses. Labour's bargaining power is probably weaker today than in the 1970s, owing to both weaker unions and international capital mobility.[11] This reduces labour's ability to demand wage catch-up. A second reason is 'globalization', or increased competition from imports. Firms prefer to maintain market share at lower margins rather than lose sales to imports, particularly the low-priced imports from Asia and China in particular. Firms therefore absorb the losses rather than raising prices. A third reason affecting both workers and firms may be that monetary policy is now more credible.[12] Thus agents in the economy know that any wage–price spiral would be crushed by the interest rate response, and therefore do not make wage or price demands in response to a rise in the price of oil. Hooker (2002) refers to Taylor's (2000) argument that low levels of inflation and inflation persistence lead to lower pricing power on the part of firms, and therefore lower pass-through of increased costs (of all kinds) to prices. However, Taylor's argument applies only to temporary rises in costs, and therefore cannot explain the lack of impact of the current sustained oil price rise.

The monetary policy explanation is clearly important, but one should also observe that the direct cost of the present oil price rise has only just reached the level of the two shocks of the 1970s. Petroleum expenditure as a share of GDP for the world, the OECD, and the US is plotted in Figure 3.

Figure 3: Petroleum expenditures as a share of GDP (percent)

[10] Allsopp (2006).
[11] This bargaining argument is made, for instance, by Rodrik (1997).
[12] As discussed in Walton (2006), for instance.



Source: Author's calculation using BP (2007) and *World Development Indicators Online*; average price over 2007 is assumed to be $80.

Taking the average of the three years leading up the shock and comparing it with the level at the peak of the shock, the rise in petroleum expenditure as a share of GDP was 3.2 percent to 1974 and 3.6 percent to 1979. The rise from the average over 2001–03 compared to 2006 is 2.3 percent; if we assume that the average oil price for 2007 will be $80 then the rise will have reached 3.3 percent. Thus on this measure we have only just reached the level of increase in oil costs that were experienced in the 1970s. It is therefore possible that we may yet see an impact on output, but the empirical work on the post-1980s period, combined with the fact that oil prices still do not seem to have fed through to core inflation, makes it seem unlikely. As of October 2007 there is some doubt that the rapid growth of the last five years will continue, but if there is a slow down then it will probably be due to credit markets and global imbalances.

Supply shocks and demand shocks[13]

One popular interpretation of the difference between the rise in oil prices today and the oil shocks of the 1970s is that the former is 'demand driven' while the latter were 'supply driven'. This is argued, for instance, in the IMF's *World Economic Outlook (WEO)* (IMF 2007) in a box entitled 'Understanding the Link Between Oil Prices and the World Economy'.

The Box compares the impact on the world economy of a supply-driven oil price shock with the impact of a demand-driven oil price shock using the IMF's Global Economic Model (GEM). In the model, 'Monetary policy is specified in terms of a credible commitment to an interest rate rule that targets inflation',[14] so the pass-through of oil

[13] This section follows Segal (2007).

[14] Reported in Elekdag et al. (2007: 6), in which the authors describe the model used for the IMF estimations. Specifically, 'In order to hit a target of 2 percent (2.5 percent in the United States) for core

prices to core inflation induces a rise in interest rates. The supply-driven oil price shock is modelled as a restriction in supply that leads to a rise in the oil price of 100 percent at its peak. This very standard exercise results in a drop in world GDP of 1.4 percent at its trough, a little over one year after the shock, while world inflation rises by 1.5 percent at its peak, after two quarters.

The second simulation in the box describes the impact of an oil price shock caused by what the *WEO* describes as a 'demand shock'. This 'demand shock' is modelled as 'a significant increase in productivity growth in oil-importing countries that permanently raises global growth by ½ of a percentage point [which] generates a significant short-run surge in oil prices that is sustained over the medium term… [reflecting] the low short-term elasticity of supply' (pp. 18-19). So what impact does this 'demand shock'-driven oil price shock have on world GDP? The *WEO* reports that 'the short-run path for world GDP is opposite to that resulting from a supply-induced increase in the price of oil because higher prices are being caused by stronger growth' (p. 19).

This analysis is problematic. I place scare-quotes around 'demand shock' because the shock that they model is a demand shock only from the point of view of the oil market: from the point of view of every other market, a rise in productivity growth is a supply shock. But worse than this, the construction of the shock tells us nothing about the impact of oil prices. Why? Because the rise in productivity growth has apparently been calibrated precisely to raise global growth by ½ a percentage point per year within the model. The *WEO*'s Figure 1 in the Box duly shows that under the 'demand shock', world GDP rises above baseline at a rate of ½ a percentage point a year. To then observe that the 'demand shock'-induced oil price shock did not prevent world GDP growth from rising by ½ a percentage point a year is simply to observe that the calibrators successfully performed the proposed calibration.

The calibrations presented in the main text of the *WEO* therefore tell us nothing about the differential impacts of different kinds of oil price shocks. The Box reports a more meaningful exercise, however, in footnote 4 (p. 19) where it is states that 'If the same increase in productivity is considered in a version of the model that does not include oil, world GDP expands by slightly more in the short and medium term than in the model with oil'. This is an appropriate comparison as it tells us whether the rise in oil prices affects GDP growth for a given rate of productivity growth. The fact that world GDP expands by only 'slightly more' without oil leads the footnote to conclude that 'This suggests that while high oil prices have resulted in a drag on world growth, these effects are relatively minor'.

While this comparison is meaningful, it is not comparable to the exercise with an oil supply-induced oil price shock, because the two different shocks involve very different sizes of increase in the price of oil. While the oil supply shock is calibrated to induce a peak rise of 100 percent in the price of oil, the 'demand shock' induces a rise in the price

---

consumer price inflation four to six quarters in the future, the change in the interest rate must be twice as large as the deviation of core inflation from its target level' (p. 9) where core inflation excludes gasoline prices.

of oil which spikes at only 35 percent in the first year (the time paths of oil prices are indicated in Figure 1 in the *WEO*). Since the induced oil price shocks are of such different magnitudes, the exercises reported in the Box tell us nothing about the difference made by the source of the oil price shock.

The analysis therefore fails to show any difference of impact between a supply-induced and a demand-induced oil price shock. But the opposition of these two types of shock has conceptual problems as well. Put simply, from the point of view of any individual country, increased world demand for oil is equivalent to reduced supply. For the US, a rise in oil consumption by China of 500 thousand barrels of oil per day is exactly equivalent to a decline in global supply of the same quantity. The only difference – which was indeed picked up by the IMF's exercise – is that in the former case the rise in demand for oil in China is probably accompanied by a rise in demand and supply of other goods from China. The economic environment will therefore be different, but this is no reason to claim that the marginal impact of the oil price rise itself will be different.

A more sophisticated analysis is provided by Kilian (2007b), who decomposes oil price movements into three components: changes in oil supply (under the assumption that supply is price-inelastic in the short run), changes in aggregate global demand (measured using an index of dry cargo single voyage freight rates), and changes in oil-specific demand. The latter includes 'shifts in the price of oil driven by higher precautionary demand associated with fears about the availability of future oil supplies' (pp. 1-2). Using a structured VAR for the global economy, he finds that oil supply shocks have a much smaller impact on oil prices than the other two types of shock (see his Figure 5). Using a similar model for the US specifically, he finds that both oil supply disruptions and oil market-specific demand shocks significantly lower US GDP growth. Aggregate demand-driven oil price increases are only partially significant at the 10 percent level. On the basis of the estimated impacts of the shocks on both output and inflation, he states that 'the risk of stagflationary responses depends very much on the origin of the oil price increase and is much more pronounced for oil demand shocks than for oil supply shocks' (p. 22). This analysis is informative about the impact of the three types of shock as Kilian defines them. But each is defined as a one standard deviation structural innovation, and each therefore has a different effect on the oil price (as shown, again, in Kilian's Figure 5). The oil-specific demand shock, in particular, has a much larger impact on the price of oil in the first two years than the other shocks. Thus it is not surprising that it has a stronger impact on other macroeconomic variables. Like the IMF exercise, it does not tell us whether the marginal impact of a given oil price rise can be expected to differ according to the cause of the rise.

6. CONCLUSION

The literature on the role of oil prices in the macroeconomy falls into two broad camps. The first analyses the effect of a rise in the oil price from a microeconomic point of view, explaining the link through various market frictions, non-competitive behaviour, and the complementarity between energy and capital. The second takes a more macroeconomic point of view, analysing the impact of oil prices on aggregate demand through inflation, and the corresponding impact of monetary policy responses. I argued that the microeconomic mechanisms, while plausible in their own right, probably were not able to explain the magnitude of the estimated impact of the oil price on the macroeconomy through the 1970s and early 1980s, and that monetary policy was the more promising explanation.

We also saw, however, that high oil prices have had no perceptible impact on the macroeconomy over the last few years, and that in the data oil price rises already stopped having an impact some time in the 1980s. At the same time, oil price rises stopped passing through to inflation, and this may hold the explanation: if oil price rises do not raise prices, then interest rates do not need to respond to them, and the impact on aggregate activity may therefore be minimal. Some hypotheses regarding why oil prices have less pass-through to core inflation were suggested, but more research on this area would seem to be required. I argued that the view that oil prices are not hurting the world economy this time around because they are 'demand driven' as opposed to 'supply driven' was implausible *a priori*, and that it is not in fact supported by the evidence adduced in its favour. It was also shown that the oil price has only just (as of late 2007) reached the magnitude of the shocks of the 1970s, in terms of total direct cost to the economy. While this may mean that the harm to the global macroeconomy is just around the corner, the existing empirical research would suggest otherwise.

REFERENCES

Allsopp, Christopher (2006): 'Why is the Macroeconomic Impact of Oil Prices Different this Time?', *Oxford Energy Forum*, Issue 66, August.

Barsky, Robert B. and Lutz Kilian (2002): 'Do We Really Know that Oil Caused the Great Stagflation? A Monetary Alternative', *NBER Macroeconomics Annual 2001*, Cambridge, Mass.: MIT Press, pp. 137–83.

---- (2004): 'Oil and the Macroeconomy since the 1970s, *The Journal of Economic Perspectives*, Vol. 18, No. 4, pp. 115–134.

Bernanke, Ben S., Mark Gertler, and Mark Watson (1997): 'Systematic Monetary Policy and the Effects of Oil Price Shocks,' *Brookings Papers on Economic Activity* 1, 91–142.

---- (2004): 'Reply: Oil Shocks and Aggregate Macroeconomic Behaviour: The Role of Monetary Policy,' *The Journal of Money, Credit and Banking*, Vol. 36, No. 2 pp. 287–291.

Bohi, Douglas (1991): 'On the Macroeconomic Effects of Energy Price Shocks', *Resources and Energy*, Vol. 13, No. 2, pp. 145–62.

Blanchard, Olivier (2002): 'Comment', *NBER Macroeconomics Annual 2001*, Cambridge, Mass.: MIT Press, pp. 183–92.

Blanchard, Olivier and Jordi Galí (2007): 'The Macroeconomic Effects of Oil Price Shocks: Why are the 2000s so different from the 1970s?', NBER Working Paper No. 13368, September.

BP (2007): *Statistical Review of World Energy 2007*, downloaded from www.bp.com.

Burbidge, John and Alan Harrison (1984), 'Testing for the Effects of Oil-Price Rises using Vector Autoregressions', *International Economic Review*, Vol. 25, No. 2, pp. 459–484.

Callen, Tim (2007): 'IMF Forecasts Slower World Growth in 2008', *World Economic Outlook*, 17 October 2007, IMF Research Department.

Darrat, Ali F., Otis W. Gilley and Don J. Meyer (1996): 'US Oil Consumption, Oil Prices, and the Macroeconomy', *Empirical Economics* 21, pp. 317–334.

Elekdag, Selim, René Lalonde, Douglas Laxton, Dirk Muir, and Paolo Pesenti (2007): 'Oil Price Movements and the Global Economy: A Model-Based Assessment', Bank of Canada, Working Paper 2007–34.

Green, Edward J. and Robert H. Porter (1984), 'Noncooperative Collusion under Imperfect Price Information', *Econometrica*, Vol. 52, No. 1, pp. 87–100.

Hamilton, James D. (1983): 'Oil and the Macroeconomy since World War II', *Journal of Political Economy*, Vol. 91, No. 2, pp. 228–248.

---- (1996): 'This is what happened to the oil price-macroeconomy relationship', *Journal of Monetary Economics*, Vol. 38, pp. 215–220.

---- (2005): 'Oil and the Macroeconomy', *mimeo,* Department of Economics, University of California, San Diego, prepared for Palgrave Dictionary of Economics.

Hamilton, James D. and Ana Maria Herrera (2004): 'Oil Shocks and Aggregate Macroeconomic Behavior: The Role of Monetary Policy', *Journal of Money, Credit, and Banking*, Vol. 36, No. 2 pp. 265–286.

Hooker, Mark A. (1996a): 'What happened to the oil price–macroeconomy relationship?', *Journal of Monetary Economics*, Vol. 38, pp. 195–213, with reply by Hamilton and final response from Hooker.

---- (1996b): 'This is what happened to the oil price–macroeconomy relationship: Reply', *Journal of Monetary Economics*, Vol. 38, pp. 221–222.

---- (1999): 'Oil and the Macroeconomy Revisited', Working Paper, Federal Reserve Board, August 1999.

---- (2002): 'Are Oil Shocks Inflationary? Asymmetric and Nonlinear Specifications versus Changes in Regime', *Journal of Money, Credit and Banking*, Vol. 34, No. 2, pp. 540–561.

Hunt, Benjamin, Peter Isard, and Douglas Laxton (2001): 'The Macroeconomic Effects of Higher Oil Prices,' IMF Working Paper WP/01/04.

Hunt, Benjamin (2005): 'Oil Price Shocks: Can They Account for the Stagflation in the 1970s?' IMF Working Paper WP/05/215.

IMF (2000): 'The Impact of Higher Oil Prices on the Global Economy', paper prepared by the IMF Research Department, December 8, 2000.

---- (2007): *World Economic Outlook*, April 2007, Washington, D.C.: IMF.

Jones, Donald W., Paul N. Leiby and Inja K. Paik (2004): 'Oil Price Shocks and the Macroeconomy: What Has Been Learned Since 1996', *The Energy Journal*, Vol. 25, No. 2, pp. 1–32.

Kilian, Lutz (2007a): 'A Comparison of the Effects of Exogenous Oil Supply Shocks on Output and Inflation in the G7 Countries', mimeo, Department of Economics, University of Michigan and CEPR [http://www-personal.umich.edu/~lkilian/kilianjeearev2.pdf].

---- (2007b): 'Not All Oil Price Shocks Are Alike: Disentangling Demand and Supply Shocks in the Crude Oil Market', mimeo, Department of Economics, University of Michigan and CEPR [http://www-personal.umich.edu/~lkilian/oil3_052107.pdf].

Leduc, Sylvain and Keith Sill (2004): 'A quantitative analysis of oil-price shocks, systematic monetary policy, and economic downturns', *Journal of Monetary Economics*, Vol. 51, pp. 781–808.

Lee, Kiseok, Shawn Ni and Ronald Ratti (1995): 'Oil Shocks and the Macroeconomy: The Role of Price Variability', *The Energy Journal*, Vol. 16, No. 4, pp. 39–56.

Mabro, Robert (1998): 'OPEC Behaviour 1960–1998: A Review of the Literature', *Journal of Energy Literature*, Vol. 4, No. 1, pp. 3–27.

Mork, Knut Anton (1989): 'Oil and the Macroeconomy When Prices go Up and Down: An Extension of Hamilton's Results', *Journal of Political Economy*, Vol. 97, No. 3, pp. 740–744.

---- (1994): 'Business Cycles and the Oil Market', *The Energy Journal*, Vol. 15, Special Issue, pp. 15–38.

Mork, Anton Knut, Hans Terje Mysen, and Oystein Olsen (1994): 'Macroeconomic Responses to Oil Price Increases and Decreases in Seven OECD Countries', *The Energy Journal*, Vol. 15, No. 4, pp. 19–35.

Orphanides, A. (2001): 'Monetary policy rules based on real-time data', *American Economic Review*, Vol. 91, pp. 964–985.

Rodrik, Dani (1997): *Has Globalization Gone Too Far?*, Institute for International Ecoomics, Washington, DC.

Rotemberg, Julio J., and Michael Woodford (1996): 'Imperfect Competition and the Effects of Energy Price Increases on Economic Activity', *Journal of Money, Credit and Banking*, Vol. 28, No. 4, Part 1, pp. 549–577.

Segal, Paul (2007): 'A note on oil prices and the world economy in the IMF's *World Economic Outlook*', Oxford Institute for Energy Studies Comment, [http://www.oxfordenergy.org/pdfs/comment_0707-2.pdf]

Solow, Robert M. (1980): 'What to do (Macroeconomically) when OPEC Comes', in Stanley Fischer, ed., *Rational Expectations and Economic Policy*, Chicago: University of Chicago Press, pp. 249–267.

Taylor, John B. (2000): 'Low inflation, pass-through, and the pricing power of firms', *European Economic Review*, Vol. 44, No. 7, pp. 1389–1408.

Walton, David (2006): 'Has oil lost the capacity to shock?' *Bank of England Quarterly Bulletin*, Spring 2006, pp. 105–114.